BINOCULAR HAVING DIGITAL IMAGE STORAGE FUNCTION

FIELD OF THE INVENTION

The present invention relates to a novel binocular, and more particularly to a binocular having digital image storage function for conveniently using in a big-scale activity for taking images and recording voices of favorite persons at a mid-range distance.

BACKGROUND OF THE INVENTION

A binocular has been developed for quite a long time and is very popular among consumers now. The binocular is often used in big-scale activities, such as ball games, musical performances, and speeches in public, for observing specific person or persons from a distant location. However, there are also people desiring to record such persons' characteristic expression or movement in addition to watch them distantly.

Digital camera has also been highly developed in recent years. It has become a widely welcomed photographing tool due to its convenience and reduced price. A disadvantage of the digital camera is it is limited to take photos of figures within a close distance due to a lens having a short focal length. When a digital

camera is used to take picture of a specific person from a long distance in a big-scale activity, the obtained image is relatively small and unclear. In the case of a high-magnification zoom lens, it is expensive and increases dimensions of the camera, making the same inconvenient for handling.

SUMMARY OF THE INVENTION

It is therefore a primary object of the present invention to integrate current digital electronic technology and optical designing skill to develop a binocular having digital image storage function that provides acceptable image quality at popular price, and is suitable for use in observing, photographing, and recording sounds or voices of things or persons at a distance about 50 to 200 meter away.

BRIEF DESCRIPTION OF THE DRAWINGS

The structure and the technical means adopted by the present invention to achieve the above and other objects can be best understood by referring to the following detailed description of the preferred embodiments and the accompanying drawings, wherein

Fig. 1 is a perspective view of a binocular having

digital image storage function according to an embodiment of the present invention;

Fig. 2 schematically shows the structure of the present invention;

Fig. 3 shows the rectangular fields of view of the binocular and the digital image storage unit of the present invention;

Fig. 4 is a block diagram of the circuitry of the digital image storage unit included in the present invention; and

Fig. 5 schematically shows a relative position of a mini liquid crystal display (LCD) included in the digital image storage unit of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Please refer to Fig. 1 that is a perspective view of an embodiment of the present invention. As shown, the present invention includes a binocular 1 and a digital image storage unit 2 of 100,000 or 350,000 pixels.

The binocular 1 includes two body tubes 11, each of which is provided at two ends with an objective lens

12 and an eyepiece 14, and at a predetermined position between the objective lens 12 and the eyepiece 14 with a prism 13, preferably a Porro prism, enabling the binocular 1 to function like a mid-range telescope.

The digital image storage unit 2 is located between the two body tubes 11. The digital image storage unit 2 is provided at an end adjacent to the objective lens 12 of the binocular 1 with a charge-coupled device (CCD) lens 21, and at one lateral side with a shutter key 22 for taking a picture and a mode-switching key 23 for switching among different functions of the digital image storage unit 2.

Unlike a conventional binocular that has a circular field of view, the binocular 1 has a specific rectangular field of view 6, as shown in Fig. 3. Meanwhile, the digital image storage unit 2 also has a rectangular field of view 7 slightly larger than the rectangular field of view 6.

Please refer to Fig. 2. The binocular 1 and the digital image storage unit 2 have parallel optical axes. Therefore, the digital image storage unit 2 can take an image identical to that observed through the binocular 1.

Fig. 4 is a block diagram of the circuitry of the digital image storage unit 2. The digital image storage unit 2 takes an image via a CCD sensor. The image taken is then sent from the CCD sensor to a microprocessor via a CCD driver, and is compressed before being stored in a memory. Any audio signal is received at a microphone and then converted into a digital signal at an analog/digital conversion circuit. The converted digital signal is then sent to the microprocessor and compressed for storing in the memory. The stored images may be displayed on a mini liquid crystal display (LCD) through a driver. The stored images and audio signals may also be output by way of connecting to a personal computer (PC) via, for example, a universal serial bus (USB).

Based on the intended use of the present invention as mentioned above, when it is supposed that the present invention is used to observe things at a distance of about 100 meters from a user, and factors, such as any possible moving of the user or observer, a manner of handling the binocular 1, a ratio of the size of an observed things to a visual field, and a preferable field of view of about 10 meters, are taken into consideration, the binocular 1 should have a view angle set to 6 degrees (that is, $2 \times \tan^{-1}(5/100) \sim 6$ degrees). Normally, the digital image storage unit 2 has a view

angle that is about 15% larger than that of the binocular 1 and is therefore set to about 7 degrees, so that the whole image that is observed via the binocular 1 could be taken by the digital image storage unit 2, as shown in Fig. 3.

The digital image storage unit 2 includes the following five major parts in its configuration:

a. Photographing module: the lens 21 focuses light beams to form an image on the photoelectric sensor CCD;

b. Signal processing: it enables CCD or CMOS (complementary metal-oxide semiconductor) photo-signals conversions;

c. Image/audio signal compression: signals are compressed to occupy reduced storage volume of the memory;

d. Image/audio signal storage: this part consists of a semiconductor memory, such as a flash random-access memory (RAM) or a static random-access memory (SRAM); and

e. Image display: this part includes a mini LCD panel.

The optical design involved in the binocular 1 is a critical technical aspect to meet the goal of supplying the present invention at a low price. In the present invention, plastic lenses replace the expensive glass lenses to obtain the same good optical performance and enable low manufacturing cost.

The binocular 1 includes an optical system having two parallel optical axes. The following are specifications for the binocular 1 of the present invention:

a. Magnifying power: 7X;

b. Rectangular field of view: having a length-to-breadth ratio of 4:3;

c. View angle: 6 degrees;

d. Objective lens clear aperture: 20mm; and

e. Resolution ratio: 8 seconds (with a diffraction limit of 7 seconds).

As having been mentioned above, the binocular 1 includes two objective lenses 12, a Porro prism 13,

and two eyepieces 14. Detailed specifications for these components are described as below:

1. The objective lenses 12:

a. Focal length: 140mm;

b. F-number: 7;

c. View angle: 6 degrees;

d. Configuration: two pieces of achromatic doublet plastic lenses; and

e. Material of lenses: PMMA (polymethyl methacrylate) and PC (polycarbonate).

2. The prism 13:

a. Clear aperture: 15mm; and

b. Material: PMMA.

3. The eyepieces 14:

a. Focal length: 20mm;

b. View angle: 42 degrees;

c. Eye relief: 10mm; and

d. Exit pupil aperture: 3mm.

The binocular 1 of the present invention has smaller objective lens clear aperture of 20mm and smaller view angle of 6 degrees, as compared to a conventional regular binocular that usually has an objective lens and clear aperture within the range from 30 to 50mm and a view angle of 8 degrees. Therefore, the binocular 1 of the present invention having the above-described specifications is suitable for use in an environment having higher brightness, such as in a ball game, an automobile racing or a musical performance held in daytime. Generally, an advantage of the binocular is its big view angle. However, a view angle of 6 degrees is sufficient when the binocular 1 is used with the digital image storage unit 2. Due to the reduced clear aperture and the reduced view angle, it is possible to replace the glass lenses with the considerably low-cost plastic lenses and thereby achieve one of the very important objects of the present invention, that is, to provide the present invention at low cost.

The digital image storage unit 2 of the present invention has the following specifications:

1. Photographing module:

   a. CCD:

      a-1) Color;

      a-2) 1/4"; and

      a-3) 300,000 pixels.

   b. Optical lens:

      b-1) Focal length: 32mm;

      b-2) F-number: 6;

      b-3) View angle: 7 degrees; and

      b-4) Material: 3-element plastic lens.

2. Signal processing: Capable of CCD or CMOS photo-signal conversions.

3. Image/audio signal compression: Signals are

compressed to occupy reduced storage volume of the memory.

4. Image/audio signal storage: This part consists of a semiconductor memory, such as a flash RAM or a SRAM.

5. Image display: A mini LCD panel 24 of 3.84mm x 2.88mm is disposed on one of the two optical axes of the binocular 1.

To enable the image taken with the digital image storage unit 2 to be shown within the field of view of the binocular 1, a semitransparent reflection mirror 3 is disposed in front of a focus of one eyepiece 14 at a 45-degree angle relative to the optical axis, and the mini LCD panel 24 is positioned at a point immediately below the focus, as shown in Fig. 5. A display status of the mini LCD 24 could be controlled through a push button on the digital image storage unit 2. For example, when the shutter key 22 is half depressed, a power supply for displaying is cut off and a user may observe distant views at the eyepieces 14 and sees what is seen with an ordinary binocular. And, when the user depresses and holds a display power key while using a hand to shield a front side of the objective lenses 12, only a magnified image on the mini

LCD is seen. That is, the user would see the exact image being taken by the digital image storage unit 2. Meanwhile, the user may observe the actual image via another body tube 11 of the binocular 1, so as to compare the actually viewed image to the image taken by the digital image storage unit 2 and checks whether a desired image is being taken.

From the above description based on an embodiment of the present invention, it is known that, by associating of the digital image storage unit 2 with the binocular 1, the user is able to observe a distant scene via the binocular 1 and see via the field of view 7 an image being taken by the digital image storage unit 2, so as to accurately take desired images.